Missouri, which was too large to be called a local storm; in fact, it seems to present phenomena characteristic of the southern end of all long troughs of low pressure. In this case the trough may be considered as extending, on the 8th, p. m., from central Kansas to southern Alberta. On the west side the cold, drier air over the Plateau Region was undoubtedly descending and pushing eastward, but had not yet made itself felt as a general westerly wind, except at Pueblo, Santa Fe, and Amarillo. In this region, which lies a little southwest of, and higher than, central Kansas, such winds prevailed, as would, by descending to the lower level of that State, produce the rise of 20° in temperature that was reported from Wichita and Dodge City, with corresponding falls in the barometer. This descending stream of air, having once reached the surface of the ground, and pushing eastward, must have presented the usual well-known appearance of an onward rolling or rushing wall of air, lifting up the lighter air in front, topped along its whole extent by a long and comparatively narrow belt of what might, to a distant observer, appear as one cloud, but which, on closer inspection, is seen to be a series of isolated whirls and hailstorms, horizontal rolls and straight-line movements, all in close juxtaposition and presenting a scene of violent, turbulent motion. At first the front was a small region, perhaps 5 miles long in the southeastern portion of Morris County, and northwestern portion of Lyon County, and therefore about 100 miles west-southwest of Kansas City, and was but the front of an entering wedge for the large mass of air to follow behind. About noon of Sunday, the 8th, the front was not only moving eastward as a whole, but also lengthening by its steady growth toward the southeast and the northwest, and by 8 p. m. had passed beyond Concordia on the north and Springfield (Mo.) on the east, and was near Kansas City. A description of the effects of the storm in southeastern Kansas, as compiled from the WEATHER REVIEW, for that State, would be about as follows:

On the east side of a line from Lyon County toward the southwest corner of Kansas the corn was blown down from the northeast and on the west side from the northwest to southeast, showing the path to have been about 25 miles wide; inside of this was an area of destructive hail about 15 miles wide, while beyond it was the area of excessive rainfall, about 60 miles wide. The hail lay in broad streaks or paths; all hailstorms [streaks?] on the east side of the center traveled [trended?] from northeast to southwest and on the west side, from northwest to southeast. In many of the hail streaks the leaves, fruit, and bark were stripped from the trees, and the next morning the groves were left bare, as in January; 4, 8, and 10 inches of water were measured in standard rain gauges, and a box standing isolated near the center of the storm path, 14 inches deep, was full of water on the morning of the 9th. This storm was succeeded by hot, dry weather. The electrical display was quite remarkable, and was reported by ovservers in Clay County, 120 miles west of Kansas City, and Reno County, 100 miles southwest of Morris and Lyon counties.

THE EARTHQUAKE OF SEPTEMBER 1.

This earthquake shook the whole of the region between Virginia and Maine, but did not extend west of the central portions of these Atlantic States. The time and character of the shocks are briefly given in the following summary:

Virginia.—Falls Church, lasted several seconds.

District of Columbia.—Washington, 6 hr. 8 min. 39 sec., a. m., by the Weather Bureau seismograph.

Maryland.—Westminster, 6.05; distinct trembling of the house for a few seconds.

Delaware.—Wilmington, slight tremor; duration one second, at 6.10.

New Jersey.—Perth Amboy, 6.08; lasted from three to ten seconds. Beverly, 6.10; lasted a full minute. Plainfield, 6.01; lasted ten seconds. Englewood, 6.10. Rancocas, 6.08. New Brunswick, 6.07. Moorestown, Newark, Clinton, Bridgeton, Oceanic, Elizabeth, Bayonne, Alaire, Somerville, Burlington, Palmyra, Freehold, and Toms River, recorded without details. Red Bank, not noticed by people out of doors, but distinctly felt by people inside of houses. Belmar, 6.08; accurately observed by Mr. Edward Brown. Asbury Park, loose plaster fell from the ceilings. Sandy Hook, in the Marine Observatory the tower shook slightly for about eight seconds. Jersey City, 6.10, at the Erie Railroad depot. Englewood, 6.10 exactly; oscillations lasted from eight to ten seconds. Port Jervis, 6.08. High Bridge, perceptible shock. Elizabeth, 6.15. Plainfield, 6.00. Trenton, between 5.00 and 6.00. New Brunswick, 5.50. Morristown, 5.45. Orange, not noticeable.

Pennsylvania.—Easton, church bell rang shortly after 6 a. m. Philadelphia, shortly after 6 a. m.; buildings swayed perceptibly. Allentown and Phœnixville, buildings swayed and many awakened from sleep.

New York.—New York, not so severe as that of August 10, 1884, August 31, 1886, or March 8, 1893; Weather Bureau office, vibrations for ten seconds at 6h. 11m. a. m. Staten Island, a strong, single shock, lasting ten seconds, occurred at 6 hr. 10 min. a. m. Governors Island, the ordinance sergeant was awakened by the shock. New York Harbor, the ferry boats rocked as in heavy weather, and a rumbling sound occurred as if the boats were scraping on the bottom. Long Island and Brooklyn, three distinct shocks; the earthquake generally travelled eastward, and was felt most decidedly on the south side of the island. Rockaway Beach, the sand continued in motion about two minutes, and the surf suddenly subsided. Bath Beach, two persons are said to have been thrown out of bed. Jamaica and Newtown, 6.05. Flushing, about 5.45. Northport and Mount Vernon, about 6.00. Yonkers, a little after 6.00. White Plains, 6.15. Sing Sing and Tarrytown, slight shock. Newburg, three gentle shocks felt at Washington Heights. Bedford, 6.06.

Connecticut.—Greenfield Hill (from the Bulletin of the New England Weather Service):

Uncorrected time, 6.08 a. m.; duration not over ten seconds; direction of movement nearly southwest to northeast. Only a few people were out at that hour, and not many of those few noticed the shock. In houses it was felt generally, and nearly all report having received the impression of the wave motion. Being in bed at the time, I felt the rocking motion; the jarring motion was felt faintly. A resident of the valley, about half a mile away from here, said his house was badly shaken. The shock passed away with a roaring sound similar to that sent back from water when a heavy gun is fired over it.

Connecticut.—Westport, houses swayed.

With reference to the accuracy of the determinations of the exact time of the earthquake shock at Washington, Mr. D. T. Maring, who (in the absence of Professor Marvin at Atlanta) was in charge of the Instrument Room at that time, writes as follows:

The time of earthquake shocks is recorded as follows: On a register cylinder, making a revolution every six hours, an ordinary office "regulator" clock marks off 5-minute intervals by closing a circuit through a magnet of the register about four seconds after the ending of each fifth minute of the hour. Whenever the needle of the seismograph is disturbed, it also records by closing a circuit through the same magnet that makes the clock record. Careful interpolation between the clock and seismograph records will, therefore, give the time by the "regulator" clock at which the needle of the seismograph was disturbed.

The accuracy of the interpolation between the clock and seismograph records will depend upon the definiteness and fineness of the lines made by the recording pen. In this particular instance the case is somewhat complicated because the seismograph record followed so closely after the clock record that the two are united into one wide mark, excepting at their points. The marks representing the clock records cover a space equivalent to about forty seconds of time, the variation in width not being greater than five seconds. The combined width of the two marks, as recorded in this instance, is equivalent to about sixty-five seconds of time on the sheet, while the distance between their points is equivalent to about twenty-five seconds. The time of the vibration of the needle of the seismograph here recorded appears, therefore, to have been made within five seconds of twenty-five seconds after the clock record was made, or at ten minutes twenty-nine seconds after 6 o'clock a. m., of September 1, 1895.

A more troublesome source of error, however, is found in the rate of the "regulator" clock. Reference to the accompanying diagram [not printed] will show that on different days the clock has gained as much as twenty seconds, or lost as much as thirty-seven seconds. For the seven days previous to September 1 the clock gained from eleven to seventeen seconds each day, the gain from noon of the 30th of August to noon of the 31st, being twelve seconds. From August 31 to September 3 no time observations were made, but during this period the clock lost twenty-eight seconds, or an average of nine seconds per day. From 9 a. m. to 12, noon, of the 3d, it gained three seconds, and from noon of the 3d to noon of the 4th, one second.

The noontime signals from the Naval Observatory are not received at this office by telegraph on Sundays nor holidays, and it so happened that September 1 fell on a Sunday, and was followed by a national holiday (Labor Day), September 2. It was not possible, therefore, to get a more accurate reduction to the actual Naval Observatory standard time than is here explained.

There seems to be no way of deciding accurately whether the regulator clock kept on gaining at the rate of twelve to fifteen seconds per day until after 6 a. m. of the 1st, or whether, between noon of the 31st and noon of the 1st it lost from twenty to forty seconds. There is, therefore, an uncertainty of at least thirty seconds in the error of the clock at 6 a. m. of September 1, and of five seconds in the interval of time that elapsed between the clock record and the seismograph record.

Adopting a mean rate for the clock from noon of the 31st to noon of the 3d, we obtain for the error of our "regulator" clock at 6 a. m. of September 1, + 1 min. 50 sec. Subtracting this error from 6 hr. 10 min. 29 sec., the time by the "regulator" clock at which the seismoscope needle was disturbed, we get 6 hr. 8 min. 39 sec. as the Naval Observatory standard seventy-fifth meridian time for the occurrence of this earthquake shock, which time is probably correct within twenty seconds.

The record of the Weather Bureau seismograph indicates that the *duration* of the shock was only a few seconds.

HOW TO OBSERVE AN EARTHQUAKE.

Prof. Charles Davison, of Birmingham, England, has been engaged for several years in studying and cataloguing the earthquakes of Great Britain, and has lately issued some instructions to observers, which are also applicable to other countries. The essential points are the following:

1. Always be prepared by keeping a written record of the correction to your watch or clock. If the record is made daily, by comparing your watch with the standard-time signal, or standard clock, and if you do not often adjust the watch, but keep its record continuously day after day, you will have the means of converting an observed time into standard time by making allowance for the error of the watch.

Immediately after the earthquake is over compare the watch or clock with other watches and clocks, especially the best standard-time clock accessible. The standard clocks of the ordinary jewelers are often allowed to be in error half a minute and are rarely adjusted to absolute correct time more than once a week or month, but by cultivating a friendship with the jeweler you can generally obtain the exact error of the clock, provided the information is to be used only for strictly scientific purposes. The standard noonday-time signal, which is flashed all over the country daily by telegraph, should always be used when possible. It can be observed at any telegraph office, and is often distributed by telephone. It is very desirable to observe the time of the shock and determine the error of the watch to the nearest second. All records should be kept in seconds, even although there may be a possible error of many seconds. Ordinary watches are liable to an irregularity in their daily rate so large that they may gain or lose ten seconds in twenty-four hours without any special apparent cause. Therefore the observer must compare his watch with the standard clock as soon as possible after the earthquake has happened. Clocks having wooden pendulums, beating seconds or half seconds, are more reliable than ordinary watches. Clocks having metallic pendulums, without compensation for changes of temperature, are less reliable than the best of the high-grade watches.

2. The most important item is the time of the instant when the strongest shock occurred. If no shock was especially strong, then record the time of the beginning and also that of the ending of the vibrations; if no shock at all is felt, record the time when the loudest rumbling noise was heard.

3. Record the nature of the shock: (*a*) Was any tremulous motion felt before the principal vibrations, and for how many seconds? (*b*) How many principal vibrations were felt, and for how many seconds did they last? (*c*) Was any tremulous motion felt after the principal vibrations, and for how many seconds? (*d*) Did the shock gradually increase in intensity and then gradually die away, or were there two or more maxima or a series of vibrations; and if so, how many were there, what were the intervals between them, and what was the order of their intensity? (*e*) Were the principal vibrations strongest near the beginning, middle, or end? (*f*) Was any vertical motion perceptible, and if so, was the movement first upward and then downward, or vice versa?

4. *Duration of the shock in seconds.*—This may be estimated after the observer has recorded the minutes and seconds of the strongest shock. To do this he should repeat at his leisure the various movements and operations that he himself went through when he observed the earthquake, and should time himself while so doing.

5. *Intensity of the shock.*—(*a*) Making windows and loose things rattle. (*b*) Perceptibly moving a chair, or bed, or the observer. (*c*) Stopping clocks, or making pendulums, pictures and chandeliers swing. (*d*) Overthrowing small ornaments or breaking the plaster from the ceiling. (*e*) Throwing down well built chimneys or cracking well built walls.

6. *The sounds.*—(*a*) Was there any unusual rumbling? (*b*) By how many seconds did the first sound precede or follow the first quaking of the earth? (*c*) By how many seconds did the last sound precede or follow the last shock? (*d*) Did the sound entirely precede, or entirely succeed the shock, and by how many seconds? (*g*) Was the sound loudest before, or at, or after the instant when the shock was strongest?

Special interest attaches to these last questions about the relation between the movement of the earth and the sound in the air. While the earthquake lasts the whole attention should be given to observing the nature of the shock and sound and their relations to one another, and their variations in intensity and character. During this time one may look at his watch and make some mark that will assist the memory, but need not write down anything except what relates to the sounds and shocks until the latter are entirely recorded, after which he may write down the record of times of beginning, maximum, and ending.

If more than one shock is felt the descriptions of the different shocks should be kept separate; slight shocks are just as important as strong ones. If you know that you are in the neighborhood of an earthquake disturbance, which you did not yourself experience, although you were in a favorable condition to do so, it is important to record that fact.

[Note.—The Editor has several times found by experience that when it is difficult to count the rather rapid vibrations of a building, it is still perfectly practicable to let a lead pencil held loosely in the hand trace a zigzag line that shall be a correct, graphic presentation of the number and intensities of each individual vibration, and this zigzag can be repeated an hour afterwards quite perfectly, both as to character and time. By counting the zigzags we thus determine the total number of vibrations, and by timing the process repeatedly we get a clear idea of the duration. Thus in the autumn of 1886 a building in Washington vibrated seven or eight times in the space of two seconds, and repeated this performance five times over within two minutes. In each case the first vibration was the largest, and the others steadily diminished to the end. Moreover, the last group was feebler than the first group.

After all that may be said in favor of personal observa-